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ECONOMIC INCENTIVES FOR THE PRODUCTION AND PROCESSING OF BULK BASE METAL SULPHIDE CONCENTRATES

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ABSTRACT

The efficient recovery of metal values from complex fine grained base metal sulfide ores has posed a serious problem to metallurgists and engineers in many parts of the world for a great many years. CANMET has demonstrated that the difficulties encountered in producing high grade selective concentrates with high recoveries from complex Zn, Pb, Cu, Ag ores can usually be circumvented by producing a bulk concentrate. This bulk concentrate however, because of its complexity and relatively low grade, must be treated in a new extraction process capable of achieving very high recoveries of all the valuable metals in the concentrate. In this presentation, two process alternatives for accomplishing this will be described, and the economic merits of each will be documented and compared to conventional technology for recovering base metals from concentrates.

Economic Incentives for the Production and Processing of Bulk Base Metal Sulphide Concentrates

As Bob Shank mentioned in his opening paper, Canada has significant deposits of complex base metal sulphide ores in many parts of the country, with some of the largest located in the Province of New Brunswick. The problems associated with efficiently recovering the valuable minerals from these complex fine grained deposits is, by now, I'm sure very familiar to all of you. About six years ago CANMET initiated studies to determine the feasibility of improving overall recovery of valuable minerals from the N.B. deposits, and thereby promote their economic exploitability. A target objective of 90% minimum average recovery was set for the four major valuable components in the ore, (namely zinc, lead, copper and silver). CANMET has demonstrated that this objective can be achieved for some ore deposits, but only if a bulk concentrate is produced. If the bulk concentrate is produced directly from the ore, grades of over 40% (combined metals) are attainable with average recoveries in excess of 90%. If one or more selective concentrates is also produced along with the bulk concentrate, overall metal recoveries can approach 90%, but the grade of bulk concentrate will be proportionately reduced. Regardless of the method of production, the bulk concentrates, because of their complexity and relatively low grade, are not amenable to conventional extraction/refining processes.

This morning you heard two excellent presentations from R.P.C. and from Sherritt Gordon on new extraction technologies which could be used for treating complex base metal sulphide bulk concentrates. This afternoon I would like to try to document for you what we think the economic incentives are for adopting these bulk concentrate/new technology options, as opposed to selective concentrate/conventional technology, for specific ore deposits. To accomplish this we have selected ore deposits from two producing mines in N.B., on which CANMET has carried out extensive studies over the past several years. The two mines are

Brunswick Mining and Smelting (BMS) and Heath Steele, and they were chosen primarily because at the present time they are the only two producing base metal mines in Canada on which we have adequate data to evaluate the bulk concentrate options. Presently they each produce selective concentrates of zinc, lead and copper, and one (BMS) also produces a bulk concentrate to improve recovery from the ore.

Typical analyses for the N.B. sulphide ores and bulk concentrates are shown in Table 1, and compared to typical conventional zinc concentrates. Major differences are the much higher iron and much lower zinc values in the bulk concentrates, as well as the higher lead, copper and silver values. The bulk concentrate analyses are based on CANMET mini-plant runs on a continuous process development unit. Tables 2 and 3 document the actual grades and recoveries of concentrates presently produced by BMS and Heath Steele Mines respectively, and compares them with the CANMET bulk concentrate data from the mini-plant runs on BMS and Heath Steele ores. The figures are based on present average ore grades and throughputs, except for BMS where the throughput figure of 1.2 million mtpy (about 35% of capacity) was chosen to provide sufficient bulk concentrate for a 90 000 mtpy zinc smelter.

Based on the CANMET data, the increased recoveries of zinc, lead, copper and silver that can be obtained in the bulk concentrates, versus the presently produced concentrates, are respectively 16%, 17%, 26.5% and 18.5% for BMS and 18%, 23%, 25% and 15% for Heath Steele. The increase in concentrate production required to achieve these recoveries is approximately 35% for BMS and only 18% for Heath Steele. This would indicate that Heath Steele ore is more amenable to bulk concentration than BMS, although the efficiency of selective concentrate production is about the same for both ores.

In addition we have estimated in Table 2 the increased bulk concentrate recovery from BMS ore when compared to the production of selective concentrates only. In this case the recovery increases become 20% for zinc, 29% for lead, 26.5% for

copper and 25.5% for silver, with a total increase in concentrate producton of about 46%.

Although these are substantial increases in overall recovery of minerals from the resource base, the value of this addition recovery is very much dependent upon the selling price of the four major metals and the efficiency of recovery in the extraction/refining process. Table 4 shows the recoveries that can be expected from the RPC Sulphation Roast Leach (SRL) Process and from the Sherritt Gordon Pressure Sulphuric Acid (PSA) leach Process. These figures are used in Table 5 to show the estimated increase in value attainable if bulk concentrates rather than selective concentrates are produced from BMS and Heath Steele ores. The figures are based on projected metal prices for the mid-1980's. Regardless of the absolute accuracy of the figures the relative percent increase in value for the bulk concentrates will remain reasonably valid. The increase will be greater if lead, copper and silver prices increase more than zinc prices, and vice versa. This is because the increase in recovery of lead, copper and silver in the bulk concentrates usually tends to be higher than for zinc. Based on the figures presented, the gross increase in value for BMS and Heath Steele is 20 and 23% respectively. However, the maximum increase in net recoverable values is lower by about 2.5% for the SRL process and 4 to 6% for the PSA process. This is primarily because of the rather poor recovery of silver in the bulk concentrate processes, compared to the conventional pyrometallurgical processes for copper and lead concentrates. The disposition of gold was also not determined in the CANMET studies, and gold is therefore not shown as a credit in the bulk concentrate processes. For BMS gold levels are too low to have a significant effect on the process economics. For Heath Steele, however, gold values are significant, and recovery of gold from the bulk concentrate will probably be economically justifiable. This could further increase the net recoverable value of the Heath Steele bulk concentrate by over 2%.

For BMS the gross and net increases in value of the bulk concentrate when compared to the production of selective

concentrates only are estimated to be 30% and 26 to 27.5% respectively.

We have looked at the possible gross and net increases in value of the bulk concentrates relative to selective concentrates for BMS and Heath Steele ores. I'd like now to look at the potential increase in net revenues that could accrue to the mines if the bulk concentrate/new technology option was implemented. In other words how much are these bulk concentrate actually worth, or how much can the processing plant afford to pay for them?

Tables 6 and 7 show the estimated net revenues that can be expected from the processing of BMS and Heath Steele concentrates. Net revenues to the mine are equal to the net value of the concentrates minus the processing costs. The processing costs for zinc, lead and copper concentrates and for the CANMET bulk concentrate are based on a new plant with about a 15% profit margin. The processing cost for BMS bulk concentrate in the Imperial Smelting Process is based on present ISP smelter charges. All costs assume that the concentrates will be processed in world scale smelters.

The cost estimate for the conventional roast-leach electrowin (RLE) process for zinc is based on a recently completed engineering feasibility study for a N.B. location. The SRL and PSA process costs are also specific to a N.B. location, but are considerably less accurate, particularly with respect to capital costs which are about ±30%. The total processing costs for the SRL and PSA processes are charged against zinc production. The additional costs shown against copper, lead and silver are those expected from processing these relatively high grade copper and lead/silver residues in the same copper and lead smelters which would be used for processing the selective copper and lead concentrates from the N.B. mines. The costs therefore, although not specific to a N.B. location are very comparative, and any differences shown reflect either the concentrate grade or the silver content. Transportation costs have been disregarded on the assumption that distances to the smelters would be the

same for both concentrates and residues, and if anything would probably favour the higher grade copper and lead/silver residues from the bulk concentrate treatment processes.

All of the processing costs in Tables 6 and 7 are shown as percentages of the net or gross metal values in the concentrates, and take into consideration the recovery penalties in the process. It would be ideal if these percentages would remain reasonably constant with time, thus allowing estimates of net revenues to be readily calculated under various metal price scenarios. However, this would imply that metal price increases should match the inflation rate, which we can attest from past experience, is extremely unlikely.

The actual figures shown are based on Canadian $0.60/lb for zinc, $0.45/lb for lead, $1.00/lb for copper, $12.00/oz for silver and $500.00/oz for gold. For the pyrometallurgical processes, by-product sulphuric acid is credited at a $10/tonne netback to the smelters. For the PSA process, sulphur recovery has not yet been demonstrated or costed. However, there is little doubt that a sulphur by-product can be recovered and a conservative netback of $25/tonne has therefore been credited to the process.

Based on the total net revenues documented in Tables 6 and 7, the bulk concentrate/new technology options could increase revenues to BMS and Heath Steele mines by 14 to 17%. For BMS the increase when compared to the production of selective concentrates only, is about 8% higher. These relative percentage increases in revenues should not be seriously affected by changes in metal prices, since the effect will be about the same for both the selective and bulk concentrate options.

For both BMS and Heath Steele, the net revenues are slightly higher for the SRL process than for the PSA process, despite the fact that PSA capital costs and total processing costs are lower. The higher SRL process revenues are primarily due to higher recoveries of silver and copper, and to a lesser extent on a higher value lead product (PbO vs $PbSO_4$). The

additional revenues accruing to the SRL process are shown in Table 8. For BMS, higher silver recovery accounts for about 50% of the gross additional revenue, while for Heath Steele, copper and silver combined account for 66% of the gross. In both cases the gross additional revenues represent about 6.5% of total mine revenues. However, the net additional revenues, after correcting for PSA process credits, are reduced to about 3% of mine revenues. Sulphur revenues from the PSA process could counterbalance acid revenues from the SRL process depending upon the relative price and marketability of the two by-products. This therefore is a very important criterion in the selection of the bulk concentrate treatment process, and in some cases could be the most important criterion.

For the bulk concentrate SRL and PSA processes and for the zinc concentrate RLE process the capital cost components of the total processing costs shown in Tables 6 and 7 have been reduced somewhat by taking advantage of tax credits eligible to producing mines in N.B. The effect that these tax credits have on the estimated net revenues to the producing mines is shown in Tables 9 and 10 for BMS and Heath Steele respectively. The revenues are related to a "base case" which is an estimate of mine revenues from the sale of concentrates to custom smelters, assuming the same amount of ore was processed to produce either selective or bulk concentrates. The figures again indicate a significant increase in net revenues to the mines is possible for the bulk concentrate processes even without the tax credits being applied. With tax credits, the bulk concentrate SRL and PSA processes increase revenues to BMS and Heath Steele by 26 to 28% and 19 to 23% respectively, while the percent increase for the selective concentrates, with a new conventional zinc smelter is 10% and 5% respectively. Without tax credits the bulk concentrate processes still increase revenues by 6 to 9%, while a conventional zinc smelter would result in a decrease in mine revenues by 3 to 6%.

In the present study we have shown that the bulk concentrate/new technology options could generate significant

additional revenues to the mines from the mining and processing of these complex base metal sulphide ores. A reasonable return on investment to the processing plant is also possible if the assumed metal prices become a reality. In addition, significant savings in the mill are possible by producing bulk rather than selective concentrates. We do not wish, however, to over simplify the problem, or suggest that this route is a panacea for all complex base metal sulphide deposits. Both the SRL and PSA processes still have to be proven on a commercial scale and each ore deposit will have to be evaluated individually to determine the improvements in resource recovery that can be achieved by producing bulk rather than selective concentrates. We already know from work carried out on the N.B. Caribou deposit that in some cases even bulk concentrates cannot be efficiently produced from the ore, in which case treatment of the whole ore may have to be considered to economically exploit the deposit. Fortunately the RPC sulphation roast leach process can be applied to sulphide ores as well as concentrates. In such a case however the mine really becomes a sulphuric acid mine with base metals as by-products. Nevertheless, this concept is presently being given serious consideration, and the economics can look favourable provided there are adequate markets for sulphuric acid.

Much work also remains to be done with respect to optimizing recoveries and grades in the bulk concentrates. Although the methods and conditions used are likely to be ore specific, we feel that further basic studies are necessary, particularly with respect to improving silver and gold recovery from these complex sulphide deposits. As mentioned earlier the disposition of gold has not been followed in the CANMET studies, although preliminary indications are that gold recovery in the bulk concentrate is less than 30% and is considerably less again in the selective concentrates. A much better understanding is required of the factors affecting gold and silver recovery in both the beneficiation and extraction/refining processes. The economic attractiveness of the SRL and PSA processes could be substantially improved if methods for increasing silver recovery,

preferably without a cyanidation circuit, can be developed. Gold recovery in the extraction processes will also have to be seriously addressed, particularly if gold revenues can account for a significant portion of total revenues. For Heath Steele, gold revenues account for over 4% of the total net mine revenues from the selective concentrates (Table 7). Gold levels in the N.B. Caribou ore are considerably higher than Heath Steele. Gold revenues therefore will contribute substantially to the economic viability of any mine mill smelter complex based on Caribou ore. It is important, therefore, in the development of the new extraction refining technologies for complex sulphide ores or bulk concentrates to strive for gold/silver recoveries which rival those from conventional pyrometallurgical processes.

Finally, while this presentation has been aimed primarily at documenting the additional revenues that could accrue to the mines by adopting the bulk concentrate/new technology options, one should not completely overlook the very significant real increase in gross revenues obtained from the resource base as a result of the increased metal recoveries. For BMS and Heath Steele, this will amount to at least 25% of the total value of minerals in the selective concentrates. This is an important aspect for both government and industry to consider when assessing the technological alternatives from the point of view of resource conservation and extending the ultimate life of the resource base.

TABLE 1:

ORE AND CONCENTRATE ANALYSES (%)

ANALYSIS	N.B. ORES	CANMET BULK CONCENTRATES	TYPICAL CONVENTIONAL ZINC CONC.
Zn	4.3 - 8.5	28 - 30	55 ± 3
Cu	0.27- 1.0	0.8 - 6.1	`0.5
Pb	1.2 - 3.5	6.4 - 11	`2
Fe	30 - 36	20 - 21	5-9
S	38	36 - 37	33
GANGUE	10 - 12	1.5	0.5-5
Ag*	55 -100	245 - 290	50

* G/MTON

TABLE 2:

GRADES AND RECOVERIES OF BMS CONCENTRATES

	Mill Prod'n	Zn			Pb			Cu			Ag		
	10^3 mpty	Grade %	Recovery %	10^3 mpty Zn	Grade %	Recovery %	10^3 mpty Pb	Grade %	Recovery %	10^3 mpty Cu	Grade g/mt	Recovery %	10^3 kg/yr Ag
Ore	1200	8.5	-	102	3.5	-	42	0.27	-	3.24	95	-	114
Zinc Conc.	140	52	72.5	74.0	2	7	-	0.20	8	-	85	10.5	12.0
Lead Conc.	68	7	4.5	-	34	56	23.5	0.6	12	-	540	30	34.2
Copper Conc.	8	3	0.2	-	7	1	-	22	51.5	1.67	3100 (1.85)*	21.5	24.5 (0.0115)*
BMS Bulk Conc.	25	31	7.5	7.6	20	12	5.0	0.7	5	-	330	7	8.0
Gross Recovery from above conc.	-	-	84.5	-	-	76	-	-	76	-	-	69	-
Net Credits from above conc.		-	80	81.6	-	68	28.5	-	51.5	1.67	-	58.5	66.7
CANMET Bulk Conc.	325	30	96	98.0	11	85	35.7	0.8	78	2.53	280	77	87.8
Increase in Recovery	35	-	16	16.4	-	17	7.2	-	26.5	0.86	-	18.5	21.1
Increase in Recovery**	46		20			29			26.5			25.5	

* Figures in brackets are gold values with copper concentrate

** Estimated increase in recovery in CANMET Bulk concentrate versus selective concentrates only

TABLE 3:

GRADES AND RECOVERIES OF HEATH STEELE CONCENTRATES

	MILL PROD'N	Zn			Pb			Cu			Ag		
	10^3 MTPY	GRADE %	RECOVERY %	10^3 MPTY Zn	GRADE %	RECOVERY %	10^3 MPTY Pb	GRADE %	RECOVERY %	10^3 MPTY Cu	GRADE g/MT	RECOVERY %	10^3 KG/YR Ag
ORE	1400	4.3	-	60	1.6	-	22	1.0	-	14	60	-	84
ZINC CONC.	90	51	75	45	1	4	-	0.5	2	-	85	9	7.5
LEAD CONC.	40	4	2.5	-	30	52	11.4	3.5	8	-	450	24	20
COPPER CONC.	35	6	4	-	5	9	-	24	60	8.4	600 (5)*	26	22 (0.175)*
GROSS RECOVERY FROM ABOVE CONC.	-	-	81.5	-	-	65	-	-	70	-	-	59	-
NET CREDITS FROM ABOVE CONC.		-	75	45	-	52	11.4	-	60	8.4	-	50	42
CANMET BULK CONC.	195	29	93	55.8	8.5	75	16.5	6.1	85	11.9	280	65	54.6
INCREASE IN RECOVERY	18	-	18	10.8	-	23	5.1	-	25	3.5	-	15	12.6

* FIGURES IN BRACKETS ARE GOLD VALUES WITH COPPER CONCENTRATE

TABLE 4:

RECOVERIES FROM BULK CONCENTRATES

	RPC (%) SRL PROCESS	SHERRITT GORDON PSA PROCESS
Zn	96	96
Pb	95	99
Cu	97	89
Ag	80	70
Cd	90	88

TABLE 5:

GROSS AND NET VALUES RECOVERABLE FROM BMS & HEATH STEELE CONCENTRATES

CONCENTRATE		BMS ($K/yr)		HEATH STEELE ($K/yr)			PROCESS
		Gross Value of Conc.	Maximum Net Value Recoverable	Gross Value of Conc.	Maximum Net Value Recoverable	Recovery in Process (%)	
Zinc	(Zn)	97,680	92,796	59,400	56,430	95	RLE Process
	(Ag)	4,620	3,927	2,887	2,454	0-85	
Lead	(Pb)	23,265	22,101	11,286	10,722	95	Sinter/Blast Furnace
	(Ag)	13,167	12,640	7,742	7,432	96	
Copper	(Cu)	3,674	3,619	18,480	18,202	98.5	Flash Smelter
	(Ag)	9,433	9,150	8,516	8,260	97	
	(Au)	185	179	2,823	2,738	97	
Bulk Conc.	(Zn)	10,032	9,631	-	-	96	ISP
	(Pb)	4,950	4,702	-	-	95	
	(Ag)	3,080	2,926	-	-	95	
Total value of above conc's		170,086	161,671	111,314	106,238		
CANMET Bulk Conc.	(Zn)	129,360	124,186	73,656	70,710	96	SRL Process
	(Pb)	35,343	33,575	16,335	15,518	95	
	(Cu)	5,566	5,399	26,180	25,395	97	
	(Ag)	33,803	27,042	21,020	16,816	80	
Total Value		204,072	190,202	137,191	128,439		
CANMET Bulk Conc.	(Zn)	129,360	124,186	73,656	70,710	96	PSA Process
	(Pb)	35,343	34,990	16,335	16,172	99	
	(Cu)	5,566	4,954	26,180	23,300	89	
	(Ag)	33,803	23,662	21,020	14,714	70	
Total Value		204,072	187,792	137,191	124,896		
% Increase In Value For Bulk Conc.*		(30.0)20.0	(27.5)17.6 (26.0)16.1	23.4	20.9 17.6		SRL Process PSA Process

* Bracketed figures show estimated % increase compared to selective concentrates only.

TABLE 6:

ESTIMATED NET REVENUES TO BMS FROM EXTRACTION/REFINING OF BMS CONCENTRATES

		Net (Gross) Production		Processing Costs (1) (% of metal value)	Net Revenues to mine $K/yr	Process
		10^3 mpty	10^3 Kg/yr			
Zinc	(Zn)	70.3		47.5 of net Zn	48 718	RLE Process (2)
	(Ag)		10.2	100 of " Ag	0	
Lead	(Pb)	22.3		64 of " Pb	7 956	Sinter/blast
	(Ag)		32.8	10 of " Ag	11 376	Furnace (2)
Copper	(Cu)	1.64		35 of " Cu	2 352	Flash Smelter(2)
	(Ag)		23.8	10 of " Ag	8 235	
	(Au)		0.0111	10 of " Au	161	
Bulk	(Zn)	7.3 (7.6)		60 of gross Zn	4 013	ISP
	(Pb)	4.75 (5.0)		55 of " Pb	2 228	
	(Ag)		7.6 (8.0)	40 of " Ag	1 756	
TOTAL REVENUES FROM ABOVE CONCENTRATES:					86 795	
CANMET	(Zn)	94.0		54.5 of net Zn	56 505	SRL Process (2)
Bulk	(Pb)	33.9		50 of " Pb	16 788	
Conc	(Cu)	2.45		40 of " Cu	3 239	
	(Ag)		70.2	10 of " Ag	24 338	
TOTAL REVENUES					100 870	
CANMET	(Zn)	94.0		52.5 of " Zn	58 988	PSA Process (3)
Bulk	(Pb)	35.3		55 of " Pb	15 746	
Conc	(Cu)	2.25		40 of " Cu	2 972	
	(Ag)		61.5	10 of " Ag	21 296	
TOTAL REVENUES					99 002	
% increase in revenues (4):					16 (24)	SRL Process
					14 (22)	PSA Process

(1) ISP costs based on existing smelter charges; all other costs based on new plant with 15% profit margin.

(2) Assumes $10/tonne netback to smelter for H_2SO_4.

(3) Assumes $25/tonne netback to zinc plant for sulphur.

(4) Bracketed figures show estimated % increase compared to selective concentrates only.

TABLE 7:

ESTIMATED NET REVENUES TO HEATH STEELE FROM EXTRACTION/REFINING OF HEATH STEELE CONCENTRATES

	Net Production 10^3 mpty	Net Production 10^3 Kg/yr	Processing Costs (1) (% of net metal value)	Net Revenues to mine $K/yr	Process
Zinc (Zn)	42.8		47.5 of Zn	29 626	RLE Process (2)
(Ag)		6.4	100 of Ag	0	
Lead (Pb)	10.8		66 of Pb	3 645	Sinter/blast Furnace (2)
(Ag)		19.2	10 of Ag	6 689	
Copper (Cu)	8.3		45 of Cu	10 011	Flash Smelter(2)
(Ag)		21.3	10 of Ag	7 434	
(Au)		0.17	10 of Au	2 464	
TOTAL REVENUES FROM ABOVE CONCENTRATES:				**59 869**	
CANMET (Zn)	53.6		54.5 of Zn	32 173	SRL Process (2)
Bulk (Pb)	15.7		50 of Pb	7 759	
(Cu)	11.55		40 of Cu	15 237	
(Ag)		43.7	10 of Ag	15 134	
TOTAL REVENUES				**70 303**	
CANMET (Zn)	53.6		52.5 of Zn	33 587	PSA Process (3)
Bulk (Pb)	16.3		55 of Pb	7 277	
(Cu)	10.6		40 of Cu	13 980	
(Ag)		38.2	10 of Ag	13 243	
TOTAL REVENUES				**68 087**	
% increase in revenues:				17	SRL Process
				14	PSA Process

(1) Based on new plant with 15% profit margin.
(2) Assumes $10/tonne netback to smelter for H_2SO_4.
(3) Assumes $25/tonne netback to zinc plant for sulphur.

TABLE 8:

ADDITIONAL NET REVENUES ACCRUING TO SRL PROCESS

	BMS		HEATH STEELE		
	$K/YR	PERCENT OF TOTAL REVENUES	$K/YR	PERCENT OF TOTAL REVENUES	REASON
COPPER	265	0.3	1255	1.8	8% HIGHER RECOVERY
LEAD	1040	1.0	480	0.7	HIGHER VALUE CONCENTRATE (5%)
SILVER	3040	3.0	1890	2.7	10% HIGHER RECOVERY
H_2SO_4	1900	1.9	1100	1.6	ASSUMING $10/TONNE NETBACK TO SMELTER
GROSS	6245	6.2	4725	6.8	
SULPHUR	(1200)	(1.2)	(825)	(1.2)	ASSUMING $25/TONNE CREDIT TO PSA PROCESS
ZINC	(2480)	(2.5)	(1400)	(2.0)	LOWER ZINC COSTS (2%)
NET	2565	2.5	2500	3.6	

TABLE 9:

COMPARISON OF NET REVENUES TO BMS ($K/YR)

METAL	ESTIMATED REVENUES FROM SALE OF CONCENTRATES (BASE CASE)	ESTIMATED NET REVENUES FOR SELECTIVE CONCENTRATES		ESTIMATED NET REVENUES FOR CANMET BULK CONCENTRATE			
				SRL PROCESS		PSA PROCESS	
		WITH TAX CREDITS FOR NEW ZINC PLANT	WITHOUT TAX CREDITS	WITH TAX CREDITS	WITHOUT TAX CREDITS	WITH TAX CREDITS	WITHOUT TAX CREDITS
ZINC (Zn)		48 718	38 046				
LEAD (Pb)		7 956	7 956				
(Ag)		11 376	11 376				
COPPER (Cu)		2 352	2 352				
(Ag)		8 235	8 235				
(Au)		161	161				
BULK (Zn)		4 013	4 013	56 505	39 118	58 988	45 328
(Pb)		2 228	2 228	16 788	16 788	15 746	15 746
(Cu)				3 239	3 239	2 972	2 972
(Ag)		1 756	1 756	24 338	24 338	21 296	21 296
TOTAL	**78 500**	**86 795**	**76 123**	**100 820**	**83 433**	**99 002**	**85 342**
% INCREASE FROM BASE CASE		10	-3	28	6	26	9

TABLE 10:

COMPARISON OF NET REVENUES TO HEATH STEELE ($K/YR)

METAL CONCENTRATE	ESTIMATED REVENUES FROM SALE OF CONCENTRATES (BASE CASE)	ESTIMATED NET REVENUES FOR SELECTIVE CONCENTRATES		ESTIMATED NET REVENUES FOR CANMET BULK CONCENTRATE			
				SRL PROCESS		PSA PROCESS	
		WITH TAX CREDITS FOR NEW ZINC PLANT	WITHOUT TAX CREDITS	WITH TAX CREDITS	WITHOUT TAX CREDITS	WITH TAX CREDITS	WITHOUT TAX CREDITS
ZINC (Zn)		29 626	29 626				
LEAD (Pb)		3 645	3 645				
(Ag)		6 689	6 689				
COPPER (Cu)		10 011	10 011				
(Ag)		7 434	7 434				
(Au)		2 464	2 464				
BULK (Zn)				32 173	22 274	33 587	25 809
(Pb)				7 759	7 759	7 277	7 277
(Cu)				15 237	15 237	13 980	13 980
(Ag)				15 134	15 134	13 243	13 243
TOTAL	57 100	59 869	53 379	70 303	60 404	68 087	60 309
% INCREASE FROM BASE CASE		5	-6	23	6	19	6